Association of Women Surgeons: Review

American association for the surgery of trauma prevention committee topical overview: national trauma data bank, geographic information systems, and teaching injury prevention

Marie Crandall, M.D., M.P.H. a,*, Ben Zarzaur, M.D., M.P.H. b, Glen Tinkoff, M.D. c

aNorthwestern University Feinberg School of Medicine, 676 N St Clair, Suite 650, Chicago, IL 60611, USA; bUniversity of Tennessee Health Science Center, Memphis, TN 38163, USA; cDepartment of Surgery, Christiana Health Care System, Newark, DE 19713, USA

KEYWORDS:
Injury prevention; Database research; Surgical education; Prevention education; Geographic information systems; Statistical analysis

Abstract

BACKGROUND: Injury is the leading cause of death for all Americans aged 1 to 35 years, and injury-related costs exceed $100 billion per year in the United States. Trauma centers can be important resources for risk identification and prevention strategies. The authors review 3 important resources for injury prevention education and research: the National Trauma Data Bank, geographic information systems, and an overview of injury prevention education.

DATA SOURCES: The National Trauma Data Bank and the Trauma Quality Improvement Program are available through the Web site of the American College of Surgeons. Links to research examples using geographic information systems software and the National Trauma Data Bank are provided in the text. Finally, resources for surgical educators in the area of injury prevention are summarized and examples provided.

CONCLUSIONS: Database research, geographic information systems, and injury prevention education are important tools in the field of injury prevention. This article provides an overview of current research and education strategies and resources.

© 2013 Elsevier Inc. All rights reserved.

Injury is the leading cause of death for all Americans aged 1 to 35 years, taking the lives of nearly 200,000 people per year. Injury-related costs, including health care, disability, and loss of productivity, exceed $100 billion per year. Injury prevention efforts may help decrease the burden of death and disability, as well as affecting health care costs and the general economy. The evolution of trauma systems and care of the critically injured patient have markedly improved outcomes after trauma, but prevention is essential to decrease the burden of injury both the United States and globally.

Trauma centers, in collaboration with prehospital personnel, the public safety community, public health experts, local community groups, faith-based organizations, and private foundations, play an increasingly important role in reducing trauma-related morbidity and mortality. Injury prevention research and education can be effective tools to further evidence-based, high-quality care.
In 2011, the American Association for the Surgery of Trauma Prevention Committee authored a “topical update” on injury prevention, covering “getting started,” “fall prevention,” “domestic violence,” and “suicide.” This article represents the second effort by the committee to provide an overview of select injury prevention tools and strategies for research and education; this installment covers the National Trauma Data Bank (NTDB), geographic information systems (GIS), and injury prevention research. It is intended to be 1 of a series of resources provided by the American Association for the Surgery of Trauma Prevention Committee, each highlighting different tools for trauma researchers and educators.

Database research

Injury surveillance and benchmarking for risk stratification are vital to both quality improvement for trauma centers and research efforts. We reviewed the NTDB Research Data Set (RDS) and the Trauma Quality Improvement Program as they relate to prevention research.

The National Trauma Data Bank

In 1989, the Regents of the American College of Surgeons established the NTDB subcommittee under the aegis of the American College of Surgeons Committee on Trauma (COT).3 The goal of this initiative was to develop a database that would serve as a national repository of data on US trauma and trauma care. After establishing a preliminary data set of 93 elements, the NTDB initiated a first call for data in 1997, accruing 1.1 million records from 405 hospitals by 2004.

However these early versions of the NTDB were hampered by the fact that the database construction for these independent hospital registries was often completed in isolation, and the actual data points contained were different in content and structure from what was being requested by the NTDB, because there was no nationally recognized standard data dictionary to ensure consistency across these registries.

In 2004, with the support of the US Health Resources and Services Administration, the American College of Surgeons COT NTDB subcommittee set out to develop a uniform data dictionary to be incorporated into all hospital trauma registries. The subcommittee, working with representatives from all the major registry vendors, defined a core set of trauma registry inclusion criteria and devised a uniform set of trauma registry variables and definitions, establishing the National Trauma Data Standard (available at http://www.ntdsdictionary.org). This data dictionary has transformed the NTDB by providing uniform and valid clinical information that can accurately monitor and characterize traumatic injury in the United States and enhance our ability to care of the injured as well as prevent or control the impact of injury.

The NTDB collects trauma registry data from participating hospitals on an annual basis. Data are aggregated and used to produce annual reports (available at http://www.ntdb.org), participating hospital benchmark reports, and data quality reports. Currently, the NTDB contains >5 million records, with the 2012 annual report (comprising entries from calendar year 2011) reporting on 773,292 records from 744 hospitals.

With the implementation on the National Trauma Data Standard and the continued growth of the NTDB, the COT has also addressed the issue of data quality with a robust edit check program known as the Validator. Data entry errors are routinely rejected and the responsible trauma centers notified for resubmission after correction. This improvement in data quality has increased interest in the use of the NTDB for research and benchmarking purposes. To meet this demand, the COT provides the NTDB RDS. The RDS can be obtained at the NTDB’s Web site (http://www.facs.org/trauma/ntdb/ntdbapp.html) and is available as an aggregate data set for 2002 to 2006 (RDS 7.2), before the implementation of the National Trauma Data Standard, and annually for 2007 to 2011 after implementation.

Whether trauma centers use the NTDB annual reports or obtain the NTDB RDS, both are useful tools for their trauma programs injury prevention efforts. They provide a resource to inform and educate trauma center personnel and the communities the serve of the prevalence and impact of the injury mechanisms to which they are exposed and mange. Furthermore, they provide available benchmarks for programs to assess themselves against to improve their effectiveness. Finally, the RDS allows investigators the potential opportunity to rigorously assess the impact our trauma centers have on the burden of injury in the United States. An example of how the RDS has been used for injury prevention research can be found in Fig. 1. Finally, many other data sets are available for individual researcher or center use, including state trauma data sets, state hospital discharge data sets, and mortality indices. Each of these may provide powerful tools to inform local prevention strategies, health policy, or quality management.

The Trauma Quality Improvement Program

The Trauma Quality Improvement Program4 is a voluntary program that uses NTDB infrastructure to provide risk-adjusted benchmarking to participating trauma centers. Each institution submits data regarding key risk and outcome measures that are standardized to the NTDB. With these data, real-time risk-adjusted observed-to-expected mortality and morbidity rates can be calculated to create a performance profile for the institution. These data may identify areas for process improvement and tertiary injury prevention, such as venous thromboembolism prophylaxis, optimizing care for traumatic brain injury, or care of the geriatric trauma patient. Although primary injury prevention strategies are not currently assessed with the Trauma Quality Improvement Program, the process can be used to profile particularly high risk populations within that
Geographic information systems

On August 28, 1854, 5-month-old Frances Lewis of 40 Broad Street, London, developed a case of diarrhea. Over the next 4 days, her mother dutifully attended to the baby by changing her many diapers, washing them, and pouring the water into the nearby cesspool. Despite her diligence and the help of the local doctor, baby Frances died on September 2, 1854. For London in the 1850s, when many children succumbed to infectious disease at an early age, this particular death seemed routine. However, baby Frances was the index case of an outbreak of cholera that would change public health forever.

Over the next several days, Dr John Snow would investigate the cases of diarrhea occurring in the Soho area of London by interviewing families and mapping the cases of cholera that were occurring in the area. Dr Snow’s investigation revealed that the majority of cholera cases occurred in close proximity to the Broad Street pump from which families in the area drew their drinking water. Dr Snow noted that the cesspool outside of 40 Broad Street had a leak and was contaminating the water in the Broad Street pump. With this evidence, Dr Snow convinced the local authorities to remove the handle from the pump at Broad Street. After the removal of the pump handle, cases of cholera dramatically decreased. Dr Snow’s investigation of the cholera outbreak in London in 1854 is the first documented use of maps to study the spread of disease. Using this geospatial information, Dr Snow was able to separate the vector (contaminated water) from the host and, thus, prevent disease.

More than 150 years later, public health researchers are using advanced geospatial mapping technology to study associations between geography and disease. One area of public health that has increasingly benefited from these technologies is injury-related research. Cockings and Martin5 developed a useful conceptual framework describing the interplay between an individual and geography in terms of health outcomes, including injury. In this framework, one becomes vulnerable to suffering an adverse health outcome through a combination of individual and behavioral factors upon exposure to environmental factors. The individual factors are characteristics such as age, gender, race, and genetics that are not modifiable. Behavioral factors are those factors that are modifiable, such as lifestyle, occupation, education, and other factors that can be modified on the basis of choice. Environmental factors are characteristics of the geography of the area, such as the natural environment (rivers, hills, mountains, etc), the built environment (the presence of sidewalks, designated bike lanes, single-family vs multifamily housing, etc), and the social characteristics (such as the socioeconomics of an area or the demographic makeup of a neighborhood). These individual, behavioral, and environmental factors are intertwined in complex ways. However, GIS can help untangle these complex relationships.

The ability to precisely locate an injury victim’s home address as well as the place where the injury occurs makes it possible to correlate precise location information about the preinjury environment and the location of the injury with the rich data available in GIS. Areas where certain types of injuries occur more frequently than expected can

---

Figure 1 NTDB and injury prevention research, alcohol-related injuries.

---

ETOH
Cowperthwaite MC, Burnett MG. Treatment course and outcomes following drug and alcohol-related traumatic injuries. J Trauma Manag Outcomes. 2011; Jan 20;5:3.


be identified using GIS techniques. Braddock et al mapped injuries occurring in Hartford, Connecticut, for people aged ≤20 years and found 2 injury “hotspots” for child pedestrian injuries. The investigators were able to target these hotspots for injury prevention education efforts as well as suggesting changes to the built environment.

Many different researcher groups around the country have used GIS technology to report the association between relative socioeconomic deprivation in a neighborhood with both blunt and penetrating injuries, which may inform policy decisions about the built environment and social policies such as mental health or policing strategies. Geospatial analysis can also be used to inform policy makers on how best to design and evaluate trauma systems. With the publication of Mackenzie et al’s study indicating that there is a significant survival benefit associated with treatment at a designated trauma center, ensuring access to trauma centers is important to policy makers. Researchers in Chicago recently identified an association between prehospital transport times, distance, and mortality from gunshot wounds, which may be used to inform discussions about trauma systems management andprehospital transport planning.

Getting started with GIS to inform injury prevention efforts at a trauma center does not need to be overly complex. To begin to use GIS, home addresses and the addresses at which injuries occurred should be made available in the trauma center’s trauma registry. Once the precise location is known, the injury location or the injured person’s home address can be mapped. Software such as ArcGIS can then be used to aggregate the injury data and determine potential hotspots. For example, a trauma center could geocode the locations of all pedestrian-struck incidents involving children and determine if hotspots exist. Using maps, the trauma center could determine if hotspots are located near certain schools or certain intersections and target their injury prevention efforts in these areas. Linking geocoded information to census data allows for more complex analysis of societal determinants of injury. Once a latitude and longitude for a particular address are known, the ZIP code or census tract group where the incident occurred or where the injured person lives can be integrated with census tract data to create a map of higher risk areas, which may inform interventions, such as engineering intersections and streets to lower speeds in areas of high pediatric pedestrian injuries.

Much like John Snow’s study of the cholera outbreak in London, mapping injuries may help us understand demographic and geographic risk factors for injury and may allow interventions to be designed to prevent injuries in these areas. GIS can be used as another tool in a trauma center’s injury prevention program. As with other advances in technology, data should be interpreted with caution while one is learning the techniques used in GIS analysis. However, once the techniques of geospatial analysis are mastered, the benefit to the community as a whole is clear.

Teaching injury prevention

Trauma surgeons have a strong tradition of injury prevention research and patient education. Although public health principles are embedded in surgical practice, a recent search of the medical literature did not identify any articles addressing injury prevention education for surgical residents or medical students on surgical rotations. The Accreditation Council for Graduate Medical Education in surgery has no specific requirements currently for population health education for residents. Despite the lack of strict guidelines on injury prevention education in surgery, there have been consistent calls to action by surgical leaders, who understand its vital importance. In a statewide survey of general surgery residents in 2000, 69% of residents believed that injury prevention education was important, but most scored poorly on a test of basic prevention knowledge. Surgeons interested in evidence-based injury prevention education can benefit from curricula that have been constructed for undergraduate medical students to help frame the problem.

The past decade has seen marked progress toward structured injury prevention education. One of the earliest models of a rigorous, medical school–based prevention curriculum was published in 2007. Phelan et al constructed competency-based strategies for undergraduate education in injury prevention. The authors posited that injury prevention education could feasibly be incorporated into existing curricula. They noted that a discussion of the benefits of bicycle helmets could be incorporated into a discussion of the anatomy and physiology of head injury in the preclinical years. They also noted that prevention education can be easily embedded into hospital teaching; real patient encounters may naturally lead to discussions of brief alcohol interventions for intoxicated patients or peripheral vision tests for older drivers. Subsequently, many institutions have adopted prevention curricula and competencies. The Association of American Medical Colleges maintains a Web site of centers dedicated to medicine and public health educational collaborations, with links to educational resources, curricula, and program evaluation data.

With some modifications, some of these teaching strategies may be incorporated into a surgical residency curriculum. Surgical residents are tasked with learning complex surgical skills, operative judgment, and optimal patient care, with diminishing hours for resident instruction. It therefore makes sense to target key precepts in the field of injury prevention with direct relevance to clinical practice and addressing core competencies, such as promoting the ability to understand the basics of injury and violence as a public health problem, assessment and use of injury and violence data, and understanding prevention strategies. Addressing each of these common injury mechanisms may be easily incorporated into didactic teaching as well as with clinical teaching of patient care. Important areas
may include motor vehicle collisions, falls, family violence, alcohol-related and drug-related injuries, and community violence. Key principles would include basic epidemiology of common injuries, the social determinants of health, and prevention strategies for basic injury mechanisms, such as motor vehicle collisions and falls (eg, speed limits and flooring choices). Providing evidence for prevention practices, such as helmet use, seatbelt use, and brief interventions, can help achieve the goal of improving injury prevention education for residents but may also be part of an organized curriculum to help trainees learn to critically assess the literature.17 Finally, a basic curriculum for continuing education in injury prevention with practical examples of prevention strategies, implementation recommendations, and case studies, could be implemented to ensure sustained knowledge and practice change.

References